

Memorandum

*Flex your power!
Be energy efficient!*

To: MR. YEN-HSI DENG
Structures Design
Office of Bridge Design-South
Bridge Design Branch 15
MS #9-3/3G

Attention: Mr. Paul Chung

Date: January 29, 2004

File: 11-SD-15-KP 30.29
11-080931
Sabre Springs D.A.R.
MSE & Type 1 Walls
Br. No. 57-1138M, 57-1139M
Br. No. 57-1140M, 57-1168M
Br. No. 57-1169M, 57-1170M
Br. No. 57-1171M, 57-1172M

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES
OFFICE OF GEOTECHNICAL DESIGN - SOUTH 2
BRANCH B, MS #5

Subject: Foundation Recommendations

This report presents the foundation recommendations for the eight proposed retaining walls (Br. No. 57-1138M through 57-1140M and Br. No. 57-1168M through 57-1172M) adjacent to the proposed abutment locations at Sabre Springs Direct Access Ramps (DAR), Br. No. 57-1135 K&S and 57-1136 K&S. The Office of Geotechnical Design South 2, Branch B (OGDS2B) completed a foundation investigation pursuant to the July 31, 2003, request by the Office of Bridge Design-South (OBDS), Branch 15, for a foundation recommendations for the proposed structures. For the Southbound On-Ramp Retaining Wall (Br. No. 57-1170M), the following foundation recommendations are only for part of the wall, from sta. 319+22.020 to sta. 319+67.020, "RW LOL" line. The Office of Geotechnical Design South 2, Branch C, will provide foundation recommendations, in a separate report, for the Southbound On-Ramp Retaining Wall (Br. No. 57-1170M) from sta. 315+0.000 to sta. 319+22.020, "RWLOL" line.

The following foundation recommendations are based on subsurface information gathered during the recent foundation investigation (April 2003 to September 2003) along with a review of subsurface information for nearby bridge structures. With regards to the current foundation recommendations given in this report, all elevations referenced within this report and shown on the Log of Test Borings (LOTB) sheets are based on the NAVD 88 vertical datum.

Project Description/History

The sites for the proposed eight retaining wall structures are located in the Sabre Springs area between the Route 56/15 Separation (Br. No. 57-0945) to the north and the Connector Separation O.C. (Br. No. 57-0944G) to the south on Route 15. These structures are part of Segment 4 of the I-15 Managed Lanes Project aimed at improving traffic mobility on Route 15 between the Escondido area and San Diego. The proposed retaining walls are part of the proposed Sabre Springs DAR and act as an intermediate structure between the roadway of the managed lanes

highway and the DAR structures. The proposed DAR structures will provide managed lane commuters access to and from the proposed Transit Center, which will be located east of this project site.

Southbound Off-Ramp Retaining Walls (Br. No. 57-1138M & 57-1139M)

The retaining walls are to be located just north of the proposed Southbound Off-Ramp structure (Br. No. 57-1136K), which will act as an intermediate structure between the Southbound Off-Ramp abutment and managed lanes. The retaining walls are positioned along the projected left edge of the bridge deck (Br. No. 57-1138M) and projected right edge of the bridge deck (Br. No. 57-1139M). At this location, the left retaining wall and right retaining wall are different lengths due to the difference in roadway elevation between the proposed managed lanes and proposed southbound lanes of the Route 15. The proposed left wall (Br. No. 57-1138M) is approximately 49.4 m in length and consists of a combination of MSE wall and Type 1 retaining wall structures. The proposed right wall (Br. No. 57-1139M) is approximately 57.8 m in length and consists of a combination of MSE wall and Type 1 retaining wall structures. The maximum MSE wall height at this location is approximately 3.8 m. Typically, the Type 1 retaining walls will be used where the proposed wall heights are 3.0 m or less. The layouts of the proposed structures are shown on the Southbound Off-Ramp Retaining Walls, General Plan No. 1, provide by OBDS, dated October 1, 2003.

Northbound Off-Ramp Retaining Walls (Br. No. 57-1140M & 57-1168M)

The retaining walls are to be located just south of the proposed Northbound Off-Ramp structure (Br. No. 57-1135K). The retaining walls are positioned along the projected left edge of the bridge deck (Br. No. 57-1168M) and projected right edge of the bridge deck (Br. No. 57-1140M). At this location, the left retaining wall and right retaining wall are different lengths due to the difference in roadway elevation between the proposed managed lanes and proposed northbound lanes of the Route 15. The proposed left wall (Br. No. 57-1168M) is approximately 101.0 m in length and consists of a combination of MSE wall and Type 1 retaining wall structures. The proposed right wall (Br. No. 57-1140M) is approximately 88.1 m in length and consists of a combination of MSE wall and Type 1 retaining wall structures. The maximum MSE wall height at this location is approximately 6.8 m. The layouts of the proposed structures are shown on the Northbound Off-Ramp Retaining Walls, General Plan No. 1, provide by OBDS, dated October 22, 2003.

Southbound On-Ramp Retaining Walls (Br. No. 57-1169M & 57-1170M)

The retaining walls are to be located just south of the proposed Southbound On-Ramp structure (Br. No. 57-1136S), which will act as an intermediate structure between the Southbound On-Ramp abutment and managed lanes. The retaining walls are positioned along the projected left edge of the bridge deck (Br. No. 57-1170M) and projected right edge of the bridge deck (Br. No. 57-1169M). At this location, the left retaining wall and right retaining wall are different lengths due to the difference in roadway elevation between the proposed managed lanes and proposed southbound lanes of the Route 15. The proposed left wall (Br. No. 57-1170M) is approximately 467.0 m in length and consists of a combination of MSE wall and Type 1 retaining wall

structures. The proposed right wall (Br. No. 57-1169M) is approximately 29.2 m in length and consists of a combination of MSE wall and Type 1 retaining wall structures. The maximum MSE wall height of the proposed left wall (Br. No. 57-1170M) from sta. 319+22.020 to sta. 319+67.020, "RW LOL" line, is approximately 7.5 m. The maximum MSE wall height of the proposed right wall (Br. No. 57-1169M) is approximately 3.8 m. The layouts of the proposed structures are shown on the Southbound On-Ramp Retaining Walls, General Plan No. 1 & No. 2, provide by OBDS, dated December 1, 2003 and December 5, 2003 respectively.

Northbound On-Ramp Retaining Walls (Br. No. 57-1171M & 57-1172M)

The retaining walls are to be located just north of the proposed Northbound On-Ramp structure (Br. No. 57-1135S), which will act as an intermediate structure between the Northbound On-Ramp abutment and managed lanes. The retaining walls are positioned along the projected left edge of the bridge deck (Br. No. 57-1172M) and projected right edge of the bridge deck (Br. No. 57-1171M). At this location, the left retaining wall and right retaining wall are different lengths due to the difference in roadway elevation between the proposed managed lanes and proposed northbound lanes of the Route 15. The proposed left wall (Br. No. 57-1172M) is approximately 64.3 m in length and consists of a combination of MSE wall and Type 1 retaining wall structures. The proposed right wall (Br. No. 57-1171M) is approximately 38.8 m in length and consists of a combination of MSE wall and Type 1 retaining wall structures. The maximum MSE wall height at this location is approximately 4.5 m. The layouts of the proposed structures are shown on the Northbound On-Ramp Retaining Walls, General Plan No. 1, provide by OBDS, dated December 12, 2003.

Geology

A review of the geologic map "Geology of the Poway Quadrangle, San Diego County, California" (Kennedy and Peterson, 1975), shows that the eight proposed retaining wall sites are located at the junction of three distinct geologic rock types: the Santiago Peak Volcanics of Jurassic age, Cretaceous undifferentiated granitic rocks of the southern California batholith, and Tertiary sedimentary deposits of the Mission Valley Formation. The foundation investigation performed for the proposed retaining wall structures consisted of 13 mud rotary borings. In addition, 25 mud rotary borings and 5 auger borings drilled for the Sabre Springs Main Access Ramp (Br. No. 57-1135) and its connecting Direct Access Ramps (Br. No. 57-1135 K&S and 57-1136 K&S) were used as supplemental information in order to properly characterize the geologic conditions at this project site. The foundation investigation revealed that, indeed, the regional geology across the site is extremely variable. In general, on the western side of the retaining wall sites, clayey gravels, silts and clays of alluvial and sedimentary origin overlay a layer of volcanic breccia, which in turn, overlays a very soft to extremely hard igneous rock, which was generally identified in the field as andesite. In general, on the eastern side of the retaining wall sites, clayey gravels, clayey sands, silty clayey sands, and clays, which were generally identified as fill material, overlay a layer of volcanic breccia, which, in turn, overlays a very soft to extremely hard igneous rock, which was generally identified in the field as diorite. The volcanic breccia layer appears to thin to the east, and was not encountered in the borings drilled for the eastern end of the Main Access Ramp structure. The foundation investigation revealed that the hardness of the igneous bedrock

underlying the area varies erratically both vertically and horizontally across the retaining wall sites.

In general, the structure of the bedrock is chaotic, and results in discontinuous, non-fractured, moderately hard to extremely hard cobble to boulder sized fragments and blocks of more competent rock within a sheared, very intensely weathered to decomposed, intensely fractured, moderately soft to very soft, rock material resulting in a soil-like matrix. Refer to the LOTB for site-specific soils and rock data.

Groundwater

The foundation investigation performed for the proposed retaining wall structures consisted of 13 mud rotary borings. In addition, 25 mud rotary borings and 5 auger borings drilled for the Sabre Springs DAR project were used as supplemental groundwater information.

During the foundation investigations of the proposed retaining walls and Sabre Springs DAR project, attempts were made to measure groundwater in 16 of the 43 rotary borings drilled. Groundwater was not encountered in 4 of the 16 borings. In the other 27 borings, no attempt was made to measure groundwater, due to varying logistical reasons, but primarily due to borings being located in existing highway lanes. All 27 of these borings were backfilled immediately after completion of drilling operations.

Approximately two months into the field investigation, it was determined that artesian groundwater conditions existed at the sites. The artesian groundwater condition was first encountered in Boring B-21-03 on July 3, 2003. The measured static groundwater level in Boring B-21-03, on July 3, 2003, was at elevation 163.20 m, approximately 1.1 m above existing ground elevation. Artesian groundwater conditions also were encountered in Borings B-25-03 and B-29-03. To further investigate the artesian groundwater conditions, five auger borings were advanced using a CME-75 drill rig until drilling refusal was reached. In four of the auger borings, B-27-03, B-28-03, B-32-03, and B-33-03, groundwater was not encountered to the maximum depths explored (2.4 m, 8.7 m, 5.6 m, and 7.4 m respectively). In Boring B-26-03, groundwater was first encountered at the bottom of the auger boring, elevation 156.7 m, at 0:15am on 7/22/2003. By 4:00am on 7/22/2003, the groundwater had risen to elevation 159.8 m, just before the boring was backfilled. In general, the auger borings did not penetrate the volcanic breccia layer, except in Boring B-28-03, where drilling refusal was reached in a very intensely weathered igneous rock layer. During the Caltrans subsurface investigation, it was found that groundwater levels varied erratically across the site. Refer to Table 1 below for measured groundwater elevations. Groundwater levels indicated in this report and LOTB reflect the measured static groundwater levels in the borehole on the specified time and date. Groundwater surface elevations are subject to seasonal fluctuations, and will be encountered at higher or lower elevations depending on conditions at time of construction.

Table 1: Summary of Groundwater Measurements

Boring No.	Date Measured	Groundwater Elevation (m)
B-10-03	9/03/2003	150.3
B-17-03	6/26/2003	154.5
B-18-03	7/02/2003	162.0
B-19-03	8/13/2003	158.6
B-20-03	8/14/2003	155.8
B-21-03	7/03/2003	163.2
B-22-03	7/17/2003	158.6
B-24-03	8/13/2003	148.9
B-25-03	7/15/2003	163.3*
B-26-03	7/22/2003	156.7/159.8**
B-29-03	7/24/2003	162.5*
B-30-03	8/27/2003	156.8
B-31-03	8/13/2003	153.1
B-37-03	9/10/2003	154.2

Note: The measured groundwater level in Boring B-21-03, on July 3, 2003, was at elevation 163.20 m, approximately 1.1 m above existing ground elevation.

* Groundwater rose to ground surface and flowed out of drilled holes. Due to lane closure and time restrictions, static groundwater elevations were not measured, the elevations shown are the existing ground elevations.

** Groundwater was first encountered at elevation 156.7 m at 0:15am on 7/22/2003. Immediately before boring was backfilled, at 4:00am on 7/22/2003, groundwater surface level was re-measured and was at elevation 159.8 m.

Scour Potential

There is no scour potential at the site, since the structures do not span any water course.

Corrosion

Composite soil samples, collected from nine borings during the 2003 foundation investigation for the Sabre Springs DAR project, were tested for corrosive potential by the Materials Engineering and Testing Services, Corrosion Technology Branch. The test results from boring samples indicated that the project site is non-corrosive. However, tested soil samples did not meet the corrosion requirements for MSE structure backfill. For specific test results, refer below to Table 2.

Table 2: Corrosion Test Summary

Boring	SIC Number	Sample Depth (m)	pH	Minimum Resistivity (ohm-cm)	Sulfate Content (PPM)	Chloride Content (PPM)
B-1-03	C599429	0.3 - 4.6	7.47	450	136	132
B-3-03	C599430	0 - 4.6	7.42	390	180	310
B-7-03	C599434	0.3 - 3.0	8.72	640	223	61
B-9-03	C599431	0 - 9.5	8.42	600	92	236
B-10-03	C599432	0 - 3.2	8.19	520	204	114
B-11-03	C599433	0.6 - 3.3	7.74	600	116	144
B-13-03	C599435	0 - 13.7	6.51	855	138	115
B-16-03	C638631	0 - 6.3	7.88	390	130	264
B-20-03	C599436	0 - 6.1	8.47	490	223	65

Note: Caltrans currently defines a site to be corrosive to foundation elements if one or more of the following conditions exist for the representative soil and/or water samples taken at the site: Chloride concentration is more than 500 ppm, sulfate concentration is greater than or equal to 2000 ppm, or the pH is 5.5 or less. For MSE structure backfill to be considered non-corrosive to both metallic soil reinforcement and reinforced concrete retaining wall, all of the following criteria must be met: Minimum resistivity must be greater than 1500 ohm-cm, chloride concentration must be less than 500 ppm, sulfate concentration must be less than 2000 ppm, and pH must be between 5.5 and 10.0.

Fault and Seismic Data

The structure site is potentially subject to strong ground motions from nearby earthquake sources during the design life of the new structure. The controlling fault for the site is the Newport-Inglewood-Rose Canyon Fault/E located approximately 18 km southwest of the site. The fault is capable of generating a Maximum Credible Earthquake moment magnitude (M_w) of 7.0 and the corresponding Peak Bedrock Acceleration is estimated to be 0.3g. At all structure locations, the potential for liquefaction is considered negligible.

For site specific seismic data and design recommendations, refer to the Final Seismic Design Recommendations memorandum, dated November 19, 2003, for the proposed Direct Access Ramp structures by Mahmoud Khojasteh of the Office of Geotechnical Design South 2.

Foundation Recommendations

The following recommendations are for the proposed retaining walls (Br. No. 57-1138M through 57-1140M and Br. No. 57-1168M through 57-1172M) associated with Sabre Springs Direct Access Ramps (Br. No. 57-1135 K&S and 57-1136 K&S). The recommendations are based on design information received from OBDS, which includes General Plan and Structure Plan sheets.

Direct Access Ramp-Southbound Off-Ramp, Retaining Walls (Br. No. 57-1138M & 57-1139M)

The proposed MSE Wall structures at the Southbound Off-Ramp were designed using information shown on the General Plan No. 1 & No. 2 (dated October 1, 2003 & October 9, 2003) and Structure Plan No. 1 & No. 2 (dated December 9, 2003 & October 10, 2003) sheets provided by OBDS. The following recommendations are for the proposed MSE Walls using backfill material with a minimum phi (ϕ) angle of 34 degrees as shown on sheet 3-8.2 in the "Bridge Design Aids" with Loading Condition 1. The Gross Allowable Soil Bearing Pressures that may be used for design are listed below in Table 3.

The proposed Type 1 Retaining Wall structures at the Southbound Off-Ramp may all be supported with spread footing foundations. The following recommendations are for Standard Type 1 Retaining Walls as shown on sheet B3-1 in the "Standard Plans (July 1999)" with Loading Case I. The Gross Allowable Soil Bearing Pressures that may be used for design are listed below in Table 3.

Table 3: Retaining Walls, DAR Southbound Off-Ramp (Br. No. 57-1138M & 57-1139M)

Structure/ Locations	Wall Type	Approx. Locations (Referenced From "56SOF" Line)	Base Width of MES Wall ³ (m)	Design Height "H" of Wall ³ (m)	Top of Leveling Pad/ Bottom Footing Elevation (m)	Recommended Soil Bearing Pressures	
						ASD ¹	LFD ²
						Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}^*)
57-1138M (Lt. Wall)	MSE Wall	5.2 m Lt., Sta. 322+02.529 to 5.2 m Lt., Sta. 322+23.529	3.0	3.75	164.27	95 kPa (2.0 ksf)	N/A
57-1138M (Lt. Wall)	Type 1 Ret Wall	5.2 m Lt., Sta. 322+23.529 to 5.2 m Lt., Sta. 322+37.929	N/A	3.00	164.12	120 kPa (2.5 ksf)	N/A
57-1138M (Lt. Wall)	Type 1 Ret Wall	5.2 m Lt., Sta. 322+37.929 to 5.2 m Lt., Sta. 322+44.929	N/A	2.40	164.42	105 kPa (2.2 ksf)	N/A
57-1138M (Lt. Wall)	Type 1 Ret Wall	5.2 m Lt., Sta. 322+44.929 to 5.2 m Lt., Sta. 322+51.929	N/A	1.80	164.42	90 kPa (1.9 ksf)	N/A
57-1139M (Rt. Wall)	MSE Wall	2.8 m Rt., Sta. 322+02.529 to 2.8 m Rt., Sta. 322+23.529	3.0	3.75	164.00	95 kPa (2.0 ksf)	N/A
57-1139M (Rt. Wall)	Type 1 Ret Wall	2.8 m Rt., Sta. 322+23.529 to 2.8 m Rt., Sta. 322+38.529	N/A	3.00	163.85	120 kPa (2.5 ksf)	N/A
57-1139M (Rt. Wall)	Type 1 Ret Wall	2.8 m Rt., Sta. 322+38.529 to 2.8 m Rt., Sta. 322+50.529	N/A	2.40	164.15	105 kPa (2.2 ksf)	N/A
57-1139M (Rt. Wall)	Type 1 Ret Wall	2.8 m Rt., Sta. 322+50.529 to 2.8 m Rt., Sta. 322+60.329	N/A	1.80	164.15	90 kPa (1.9 ksf)	N/A

Notes: 1) Allowable Stress Design, ASD. The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 2 times the recommended Gross Allowable Soil Bearing Pressure, (q_{all}) for MSE walls, and 3 times the recommended Gross Allowable Soil Bearing Pressure, (q_{all}) for Type 1 retaining walls.
2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*).
3) Information regarding the base width and design height of MSE walls was provided by OBDS on December 31, 2003.

Direct Access Ramp-Northbound Off-Ramp, Retaining Walls (Br. No. 57-1140M & 57-1168M)

The proposed MSE Wall structures at the Northbound Off-Ramp were designed using information shown on the General Plan No. 1 & No. 2 (dated October 22, 2003 & October 23, 2003) and Structure Plan No. 1, No. 2, No. 3, & No. 4 (dated October 23, 2003, October 22, 2003, October 25, 2003, & October 22, 2003) sheets provided by OBDS. The following recommendations are for the proposed MSE Walls using backfill material with a minimum ϕ angle of 34 degrees as shown on sheet 3-8.2 in the "Bridge Design Aids" with Loading Condition 1. The Gross Allowable Soil Bearing Pressures that may be used for design are listed below in Table 4.

The proposed Type 1 Retaining Wall structures at the Northbound Off-Ramp may all be supported with spread footing foundations. The following recommendations are for Standard Type 1 Retaining Walls as shown on sheet B3-1 in the "Standard Plans (July 1999)" with Loading Case I. The Gross Allowable Soil Bearing Pressures that may be used for design are listed below in Table 4.

Table 4: Retaining Walls, DAR Northbound Off-Ramp (Br. No. 57-1140M & 57-1168M)

Structure/ Locations	Wall Type	Approx. Locations (Referenced From "56NOF" Line)	Base Width of MES Wall ³ (m)	Design Height "H" of Wall ³ (m)	Top of Leveling Pad/ Bottom Footing Elevation (m)	Recommended Soil Bearing Pressures	
						ASD ¹	LFD ²
						Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}^*)
57-1140M (Rt. Wall)	Type 1 Ret Wall	6.4 m Rt., Sta. 318+87.270 to 6.4 m Rt., Sta. 318+95.570	N/A	1.80	160.80	90 kPa (1.9 ksf)	N/A
57-1140M (Rt. Wall)	Type 1 Ret Wall	6.4 m Rt., Sta. 318+95.570 to 6.4 m Rt., Sta. 319+03.070	N/A	2.40	160.80	105 kPa (2.2 ksf)	N/A
57-1140M (Rt. Wall)	Type 1 Ret Wall	6.4 m Rt., Sta. 319+03.070 to 6.4 m Rt., Sta. 319+19.870	N/A	3.00	160.50	120 kPa (2.5 ksf)	N/A
57-1140M (Rt. Wall)	MSE Wall	6.4 m Rt., Sta. 319+19.870 to 6.4 m Rt., Sta. 319+28.870	3.0	3.75	160.60	95 kPa (2.0 ksf)	N/A
57-1140M (Rt. Wall)	MSE Wall	6.4 m Rt., Sta. 319+28.870 to 6.4 m Rt., Sta. 319+46.870	3.6	4.50	160.60	130 kPa (2.7 ksf)	N/A
57-1140M (Rt. Wall)	MSE Wall	6.4 m Rt., Sta. 319+46.870 to 6.4 m Rt., Sta. 319+58.870	4.2	5.25	160.60	145 kPa (3.0 ksf)	N/A
57-1140M (Rt. Wall)	MSE Wall	6.4 m Rt., Sta. 319+58.870 to 6.4 m Rt., Sta. 319+70.870	4.2	6.00	160.60	160 kPa (3.4 ksf)	N/A
57-1140M (Rt. Wall)	MSE Wall	6.4 m Rt., Sta. 319+70.870 to 6.4 m Rt., Sta. 319+75.370	4.8	6.75	160.60	170 kPa (3.6 ksf)	N/A
57-1168M (Lt. Wall)	Type 1 Ret Wall	1.6 m Lt., Sta. 318+74.370 to 1.6 m Lt., Sta. 318+86.370	N/A	1.80	160.74	90 kPa (1.9 ksf)	N/A
57-1168M (Lt. Wall)	Type 1 Ret Wall	1.6 m Lt., Sta. 318+86.370 to 1.6 m Lt., Sta. 318+95.570	N/A	2.40	160.74	105 kPa (2.2 ksf)	N/A
57-1168M (Lt. Wall)	Type 1 Ret Wall	1.6 m Lt., Sta. 318+95.570 to 1.6 m Lt., Sta. 319+12.370	N/A	3.00	160.44	120 kPa (2.5 ksf)	N/A
57-1168M (Lt. Wall)	MSE Wall	1.6 m Lt., Sta. 319+12.370 to 1.6 m Lt., Sta. 319+34.870	3.0	3.75	160.84	95 kPa (2.0 ksf)	N/A
57-1168M (Lt. Wall)	MSE Wall	1.6 m Lt., Sta. 319+34.870 to 1.6 m Lt., Sta. 319+48.370	3.6	4.50	160.84	130 kPa (2.7 ksf)	N/A
57-1168M (Lt. Wall)	MSE Wall	1.6 m Lt., Sta. 319+48.370 to 1.6 m Lt., Sta. 319+60.370	4.2	5.25	160.84	145 kPa (3.0 ksf)	N/A
57-1168M (Lt. Wall)	MSE Wall	1.6 m Lt., Sta. 319+60.370 to 1.6 m Lt., Sta. 319+70.870	4.2	6.00	160.84	160 kPa (3.4 ksf)	N/A
57-1168M (Lt. Wall)	MSE Wall	1.6 m Lt., Sta. 319+70.870 to 1.6 m Lt., Sta. 319+75.370	4.8	6.75	160.84	170 kPa (3.6 ksf)	N/A

Notes: 1) Allowable Stress Design, ASD. The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 2 times the recommended Gross Allowable Soil Bearing Pressure, (q_{all}) for MSE walls, and 3 times the recommended Gross Allowable Soil Bearing Pressure, (q_{all}) for Type 1 retaining walls.

2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*).

3) Information regarding the base width and design height of MSE walls was provided by OBDS on December 31, 2003.

Direct Access Ramp-Southbound On-Ramp, Retaining Walls (Br. No. 57-1169M & 57-1170M)

The proposed MSE Wall structures at the Southbound On-Ramp were designed using information shown on the General Plan No. 1, No. 2 & No. 3 (dated December 1, 2003, December 5, 2003, & December 5, 2003) and Structure Plan No. 1 & No. 8 (dated September 3, 2003 & December 19, 2003) sheets provided by OBDS. The following recommendations are for the proposed MSE Walls using backfill material with a minimum ϕ angle of 34 degrees as shown on sheet 3-8.2

in the "Bridge Design Aids" with Loading Condition 1. The Gross Allowable Soil Bearing Pressures that may be used for design are listed below in Table 5.

The proposed Type 1 Retaining Wall structures at the Southbound On-Ramp may all be supported with spread footing foundations. The following recommendations are for Standard Type 1 Retaining Walls as shown on sheet B3-1 in the "Standard Plans (July 1999)" with Loading Case I. The Gross Allowable Soil Bearing Pressures that may be used for design are listed below in Table 5.

Table 5: Retaining Walls, DAR Southbound On-Ramp (Br. No. 57-1169M & 57-1170M)

Structure/ Locations	Wall Type	Approx. Locations (Referenced From "S6SON" Line)	Base Width of MES Wall ³ (m)	Design Height "H" of Wall ³ (m)	Top of Leveling Pad/ Bottom Footing Elevation (m)	Recommended Soil Bearing Pressures	
						ASD ¹	LFD ²
						Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}^*)
57-1169M (Rt. Wall)	Type 1 Ret Wall	2.8 m Rt., Sta. 319+37.820 to 2.8 m Rt., Sta. 319+46.020	N/A	2.40	163.40	105 kPa (2.2 ksf)	N/A
57-1169M (Rt. Wall)	MSE Wall	2.8 m Rt., Sta. 319+46.020 to 2.8 m Rt., Sta. 319+55.020	2.4	3.00	163.80	85 kPa (1.8 ksf)	N/A
57-1169M (Rt. Wall)	MSE Wall	2.8 m Rt., Sta. 319+55.020 to 2.8 m Rt., Sta. 319+67.020	3.0	3.75	163.80	95 kPa (2.0 ksf)	N/A
57-1170M (Lt. Wall)	MSE Wall	5.2 m Lt., Sta. 319+22.020 to 5.2 m Lt., Sta. 319+28.020	5.4	6.75	159.24	160 kPa (3.4 ksf)	N/A
57-1170M (Lt. Wall)	MSE Wall	5.2 m Lt., Sta. 319+28.020 to 5.2 m Lt., Sta. 319+43.020	5.4	6.75	159.24	160 kPa (3.4 ksf)	N/A
57-1170M (Lt. Wall)	MSE Wall	5.2 m Lt., Sta. 319+43.020 to 5.2 m Lt., Sta. 319+59.520	5.4	6.75	159.24	160 kPa (3.4 ksf)	N/A
57-1170M (Lt. Wall)	MSE Wall	5.2 m Lt., Sta. 319+59.520 to 5.2 m Lt., Sta. 319+67.020	6.0	7.50	159.24	165 kPa (3.5 ksf)	N/A

Notes: 1) Allowable Stress-Design, ASD. The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 2 times the recommended Gross Allowable Soil Bearing Pressure, (q_{all}) for MSE walls, and 3 times the recommended Gross Allowable Soil Bearing Pressure, (q_{all}) for Type 1 retaining walls.
2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*).
3) Information regarding the base width and design height of MSE walls was provided by OBDS on December 31, 2003.

Direct Access Ramp-Northbound On-Ramp, Retaining Walls (Br. No. 57-1171M & 57-1172M)

The proposed MSE Wall structures at the Northbound On-Ramp were designed using information shown on the General Plan No. 1 & No. 2 (both dated December 12, 2003) and Structure Plan No. 1 & No. 2 (both dated October 25, 2003) sheets provided by OBDS. The following recommendations are for the proposed MSE Walls using backfill material with a minimum ϕ angle of 34 degrees as shown on sheet 3-8.2 in the "Bridge Design Aids" with Loading Condition 1. The Gross Allowable Soil Bearing Pressures that may be used for design are listed below in Table 6.

The proposed Type 1 Retaining Wall structures at the Northbound On-Ramp may all be supported with spread footing foundations. The following recommendations are for Standard Type 1

Retaining Walls as shown on sheet B3-1 in the "Standard Plans (July 1999)" with Loading Case I. The Gross Allowable Soil Bearing Pressures that may be used for design are listed below in Table 6.

Table 6: Retaining Walls, DAR Northbound On-Ramp (Br. No. 57-1171M & 57-1172M)

Structure/ Locations	Wall Type	Approx. Locations (Referenced From "56NON" Line)	Base Width of MES Wall ³ (m)	Design Height "H" of Wall ³ (m)	Top of Leveling Pad/ Bottom Footing Elevation (m)	Recommended Soil Bearing Pressures	
						ASD ¹	LFD ²
						Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}^*)
57-1171M (Rt. Wall)	MSE Wall	5.2 m Rt., Sta. 321+97.135 to 5.2 m Rt., Sta. 322+18.135	3.0	3.75	164.60	95 kPa (2.0 ksf)	N/A
57-1171M (Rt. Wall)	Type 1 Ret Wall	5.2 m Rt., Sta. 322+18.135 to 5.2 m Rt., Sta. 322+29.635	N/A	2.40	164.20 & 164.50	105 kPa (2.2 ksf)	N/A
57-1171M (Rt. Wall)	Type 1 Ret Wall	5.2 m Rt., Sta. 322+29.635 to 5.2 m Rt., Sta. 322+35.935	N/A	1.80	164.50	90 kPa (1.9 ksf)	N/A
57-1172M (Lt. Wall)	MSE Wall	2.8 m Lt., Sta. 321+97.135 to 2.8 m Lt., Sta. 322+07.635	3.6	4.50	163.84	130 kPa (2.7 ksf)	N/A
57-1172M (Lt. Wall)	MSE Wall	2.8 m Lt., Sta. 322+07.635 to 2.8 m Lt., Sta. 322+22.635	3.0	3.75	163.84	95 kPa (2.0 ksf)	N/A
57-1172M (Lt. Wall)	Type 1 Ret Wall	2.8 m Lt., Sta. 322+22.635 to 2.8 m Lt., Sta. 322+39.335	N/A	3.00	164.14	120 kPa (2.5 ksf)	N/A
57-1172M (Lt. Wall)	Type 1 Ret Wall	2.8 m Lt., Sta. 322+39.335 to 2.8 m Lt., Sta. 322+47.635	N/A	2.40	164.14	105 kPa (2.2 ksf)	N/A
57-1172M (Lt. Wall)	Type 1 Ret Wall	2.8 m Lt., Sta. 322+47.635 to 2.8 m Lt., Sta. 322+61.435	N/A	1.80	164.14	90 kPa (1.9 ksf)	N/A

Notes: 1) Allowable Stress Design, ASD. The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 2 times the recommended Gross Allowable Soil Bearing Pressure, (q_{all}) for MSE walls, and 3 times the recommended Gross Allowable Soil Bearing Pressure, (q_{all}) for Type 1 retaining walls.
2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*).
3) Information regarding the base width and design height of MSE walls was provided by OBDS on December 31, 2003.

General Notes:

1. All support locations are to be plotted in plan view on the Log of Test Borings as stated in "Memo to Designers" 4-2. The plotting of support locations should be made prior to requesting a final foundation review.
2. The base width of all MSE walls in this report is defined as the distance from the back face of panel extending to the furthest point of the reinforcement mat.

Construction Considerations:

1. Groundwater was encountered during the 2003 field investigation for the Sabre Springs DAR project. It was found during the Caltrans subsurface investigation that groundwater levels varied erratically across the bridge sites. During the Caltrans field investigation, artesian groundwater conditions were also encountered in three borings. Refer to the LOTB sheets

and the Groundwater section in this report for measured static groundwater elevations. The groundwater surface elevation is subject to seasonal fluctuations and will be encountered at higher or lower elevations than shown on the LOTB sheets and this report depending on conditions at time of construction.

2. Concrete for all Type 1 Retaining Wall footings shall be placed neat against the undisturbed earth materials or engineered fills at the bottom of the footing excavation elevation listed in this report. Should the bottom of footing excavation be disturbed, then the disturbed soil shall be recompacted to 95% relative compaction prior to placement of concrete for the Type 1 Retaining Wall footings.
3. For the Northbound On-Ramp retaining walls (Br. No. 57-1171M & 57-1172M), and the Southbound On-Ramp left MSE Wall (Br. No. 57-1170M), from sta. 319+22.020 to sta. 319+67.020, "RW LOL" line, and the right MSE and Type 1 retaining walls (Br. No. 57-1169M), the contractor is to allow a 60 day settlement period prior to begin construction of the approach slab, concrete barrier, and barrier slab along the top of the walls. The waiting period maybe reduced if the contractor chooses to monitor the settlement and provide evidence that settlement has ceased. Monitoring devices may consist of settlement monuments on each wall starting at the maximum wall height extending to the end of the wall. Each wall should have no less than 4 settlement monuments. Monuments are to be placed after completion of wall construction.

The recommendations contained in the report are based on specific project information regarding structure type, support locations, and loading conditions provided by OBDS. If any conceptual changes are made during final project design, the Office of Geotechnical Design-South 2, Branch B should review those changes to determine if these foundation recommendations are still applicable. Any questions regarding the above recommendations should be directed to the attention of D. TM Liao (916) 227-5756 (CALNET 498-5756) or Mark DeSalvatore (916) 227-5391 (CALNET 498-5391), Office of Geotechnical Design South 2-Branch B.

Prepared by:

Date: 1/29/04

Supervised by:

Date: 1/29/04

Erich Neupert

Erich Neupert
Engineering Geologist
Office of Geotechnical Design-South 2
Branch B

Mark DeSalvatore

Mark DeSalvatore, R.C.E.# 039499
Senior Materials and Research Engineer
Office of Geotechnical Design-South 2
Branch B

Prepared by:

Date: 1/29/04

D. Te-Ming Liao

D. Te-Ming Liao, R.C.E.# 59838
Transportation Engineer-Civil
Office of Geotechnical Design-South 2
Branch B



cc: R.E. Pending File

John Stayton – Specs & Estimates (4)
Dave Pajouhesh – PCE
Lawrence Carr – District 11 (Project Manager)
Marcelo Peinado – District 11 (Design Project Manager)
Abbas Abghari – OGDS-2
Brian Hinman – OGDS-2
Project File – North
Project File – South